UAD Pendidikan Program Doktor
p-ISSN: 3048-4324
e-ISSN: 3048-4316
CECE
https://journal1.uad.ac.id/index.php/CECE
Contemporary Education and Community Engagement

Effectiveness of the Scramble Learning Model on Students' Ability to Understand Mathematical Concepts

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DOI: 10.12928/cece.v1i2.1282
Received: February 2nd, 2025. Revised: March 1st, 2025. Accepted: March 8th, 2025
Available Online: March 11th, 2025. Published Regularly: January 31st, 2025

ABSTRACT

This study aims to analyze the effectiveness of the use of the Scramble type cooperative learning model on the mathematical concept understanding ability of class VII students of Muhammadiyah 1 Mlati Junior High School: A Quasi-experimental Study with a Posttest Only Control Design consisting of two groups, namely the experimental class treated with the Scramble learning model (VII-B with 30 students) and the control class using conventional learning (VII-C with 30 students). The results of this study indicate that the sig. 2-tailed 0.000 < 0.05, which indicates a significant effect of the application of the Scramble model on the understanding of mathematical concepts. This study provides an important contribution to the development of more innovative mathematics teaching methods, where the implementation of learning from the teacher's side is quite high, namely 97.91% with an excellent category, while the implementation of learning by students reaches 96.15% with an excellent category.

Keywords: Effectiveness, Scramble Learning Model, Understanding Mathematical Concepts

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INTRODUCTION

Mathematics is one of the subjects that plays a crucial role in the field of education [1]. As a discipline that trains logical, systematic, and analytical thinking skills, mathematics is expected to shape students' thought processes in solving various real-life problems [2]. However, in practice, many students face difficulties in understanding mathematical concepts. These difficulties are often caused by unengaging teaching methods that tend to be teacher-centered, making students passive in the learning process [3], [4]. This condition negatively impacts students' learning outcomes and results in suboptimal conceptual understanding. Therefore, it is necessary to implement a learning model that can enhance students' active participation and strengthen their understanding of mathematical concepts.

One effective learning model for improving students' understanding of mathematical concepts is the cooperative learning model [5], [6]. This model emphasizes collaboration among students in completing tasks in groups, allowing them to help each other and share their understanding of the material being studied. In cooperative learning, student interactions become more active, enabling discussions, question-and-answer sessions, and deeper exploration of concepts [7], [8]. Thus, students do not merely receive information passively but also build their understanding through peer interactions.

One particularly engaging type of cooperative learning is the Scramble model. The cooperative learning Scramble model integrates game elements into the learning process, where students are given pieces of information or questions that they must correctly arrange to obtain the correct answers [9]. This model not only increases student engagement in learning but also trains them to think quickly, understand concepts more effectively, and enhance their problem-solving skills [10]. By incorporating game elements into the learning process, students are expected to be more motivated and less likely to experience boredom.

Another advantage of the cooperative learning Scramble model is its ability to improve students' social skills [11]. In this model, students are required to work in groups, discuss mathematical concepts, and find the best solutions in arranging the correct answers. This approach encourages students to actively communicate, engage in debates, and learn from their peers' experiences. Furthermore, the model helps students develop self-confidence and independent thinking skills [12]. Thus, learning is not only focused on conceptual understanding but also on developing essential social skills for real-life situations.

However, previous studies on the cooperative learning Scramble model still have some limitations. Some studies have focused solely on increasing students' learning motivation without exploring in depth how this model specifically influences their understanding of mathematical concepts [13]. Additionally, existing research has tended to be conducted at specific educational levels, such as elementary or high school, while studies at the junior high school level remain limited [14]. Another factor that has received little attention is teachers' readiness to implement this model effectively and the challenges that arise in its application in heterogeneous classrooms [15]. Therefore, this study aims to address these limitations by exploring the effectiveness of the cooperative learning Scramble model in enhancing students' understanding of mathematical concepts more comprehensively.

At Muhammadiyah 1 Mlati Junior High School, the low level of conceptual understanding of mathematics among seventh-grade students presents a significant challenge in the learning process. Based on initial observations, many students struggle to understand mathematical concepts, particularly abstract ones. One contributing factor is the conventional teaching methods that do not actively engage students. Consequently, students' interest and motivation in learning mathematics decline, leading to unsatisfactory learning outcomes [16], [17]. Therefore, an innovative learning approach is needed to enhance the effectiveness of mathematics learning at this school.

Research on the effectiveness of the cooperative learning Scramble model in improving students' understanding of mathematical concepts is crucial. By investigating the effectiveness of this model, empirical evidence can be obtained regarding its impact on students' conceptual understanding [18], [19]. Moreover, this study can provide valuable insights for teachers in selecting more effective teaching strategies tailored to students' needs. Through this research, it is expected that mathematics learning at Muhammadiyah 1 Mlati Junior High School will become more engaging, enjoyable, and capable of significantly improving students' conceptual understanding.

Furthermore, the findings of this study can serve as a reference for schools in developing more innovative learning policies [20], [21]. If the cooperative learning Scramble model proves

to be effective in enhancing students' mathematical conceptual understanding, schools can adopt it as a recommended teaching method for educators. Thus, the implementation of this model not only benefits students in grasping mathematical concepts but also contributes to the overall improvement of education quality at the school [22].

Based on the discussion above, this study aims to analyze the effectiveness of the cooperative learning Scramble model in enhancing the conceptual understanding of mathematics among seventh-grade students at Muhammadiyah 1 Mlati Junior High School. Through this research, it is expected that valuable information will be obtained as a foundation for developing more innovative, interactive, and effective learning strategies to improve students' mathematical conceptual understanding.

METHOD

This type of research is quasi-experimental research, namely research carried out without considering students' internal and external factors [23]. This research was carried out at Muhammadiyah 1 Mlati Middle School, located on Jalan Magelang km 8, Sinduadi, Mlati, Sleman, Special Region of Yogyakarta, in January 2025, adjusted to the mathematics lesson schedule in the even semester of the 2024/2025 academic year. The research design used was Posttest Only Control Design, which consisted of two groups, namely the experimental class which was treated with the Scramble learning model and the control class which was not treated or used conventional learning. After the treatment was given, both groups were then given a posttest to measure students' ability to understand concepts referring to Lestari & Yudhanegara [24] with indicators, namely restating a concept (A), classifying objects according to certain properties in accordance with the concept (B), giving examples and non-examples of a concept (C), presenting concepts in various forms of mathematical representation (D), developing necessary or sufficient conditions for a concept (E), using and selecting certain procedures or operations (F), applying concepts or algorithms to problem solving (G)

Data collection techniques in this research were carried out through interviews, observations and tests. Data analysis techniques include validity, reliability, discrimination and difficulty index tests on the test instruments used before being given to both classes (experimental and control). The prerequisite tests carried out in this research include normality and homogeneity tests, while hypothesis testing uses the independent sample t-test to see differences in learning outcomes between the experimental class and the control class.

RESULTS AND DISCUSSION

Result

This research was conducted in January 2025, where the Scramble model learning was given to the experimental class (VII-B) with steps based on Shoimin [25], namely first, the teacher prepares learning materials and media. Second, the teacher forms heterogeneous groups for discussion and presentation of work results. Third, the teacher provides enrichment through individual assignments. During the research, the researcher was accompanied by three observers to observe and provide input on the learning carried out. The implementation of learning is adjusted to the open module that has been created by the researcher. The description of the research trial data is in the form of the results of the analysis of the posttest instrument for the ability to understand mathematical concepts that have been tested in class IX-A with the following details.

Table 1. Results of Validity, Reliability, Difficulty Level and Differentiating Power

No	Validity ($r_{table} = 0,361$)		Reliability (*Cronbach's Alpha*)		Difficulty Level		Differentiating Power		Information
	r_{count}	Criteria	Value	Criteria	DL	Criteria	DP	Criteria	
1a	0,446	Valid	0,770	Reliable	0,73	Easy	0,25	Enough	Used
1b	0,461	Valid			0,74	Easy	0,27	Enough	Used
2a	0,557	Valid			0,69	Currently	0,22	Enough	Used
2b	0,565	Valid			0,34	Currently	0,22	Enough	Used
2c	0,543	Valid			0,34	Currently	0,51	Good	Used
2d	0,666	Valid			0,68	Currently	0,50	Good	Used
2e	0,446	Valid			0,49	Currently	0,23	Enough	Used
3a	0,421	Valid			0,43	Currently	0,33	Enough	Used
3b	0,364	Valid			0,54	Currently	0,24	Enough	Used
3c	0,552	Valid			0,65	Currently	0,23	Enough	Used
4a	0,543	Valid			0,34	Currently	0,25	Enough	Used
4b	0,629	Valid			0,33	Currently	0,27	Enough	Used
4c	0,527	Valid			0,70	Easy	0,33	Enough	Used
5a	0,666	Valid			0,55	Currently	0,40	Enough	Used
5b	0,485	Valid			0,73	Easy	0,27	Enough	Used
5c	0,620	Valid			0,65	Currently	0,37	Enough	Used
6	0,631	Valid			0,65	Currently	0,27	Enough	Used

Based on the table above, there are 17 question numbers with validity results with valid and reliable criteria, the majority's difficulty index is moderate, the majority's discriminating power has sufficient criteria, so these 17 question numbers can be used. After the instrument is valid and reliable, it is then used during the pretest and posttest. The observation data was obtained from the observations of three observers and then the average was calculated. The results of observations in the experimental class can be seen in the following table.

Table 2. Teacher Implementation Results

	Percentage			Criteria
	Meeting I	Meeting II	Average	
Teacher	95,83%	100%	97,91%	Very Good

Table 3. Student Implementation Results

	Percentage					Criteria
	Meeting 1		Meeting 2		Average	
	Observer 1	Observer 2	Observer 1	Observer 2		
Students	92,82%	98,46%	98,46%	94,87%	96,15%	Very Good

Based on the table above, the average implementation of learning using the Scramble learning model for teachers reached 97,91% with one aspect that was not used in research and had very good criteria, and for students it reached 96,15%, so it can be concluded that the percentage of implementation of learning using the Scramble learning model is in accordance with the aspects observed. Meanwhile, the posttest results for each indicator of the ability to understand mathematical concepts for students in the experimental class and control class can be seen in the following picture.

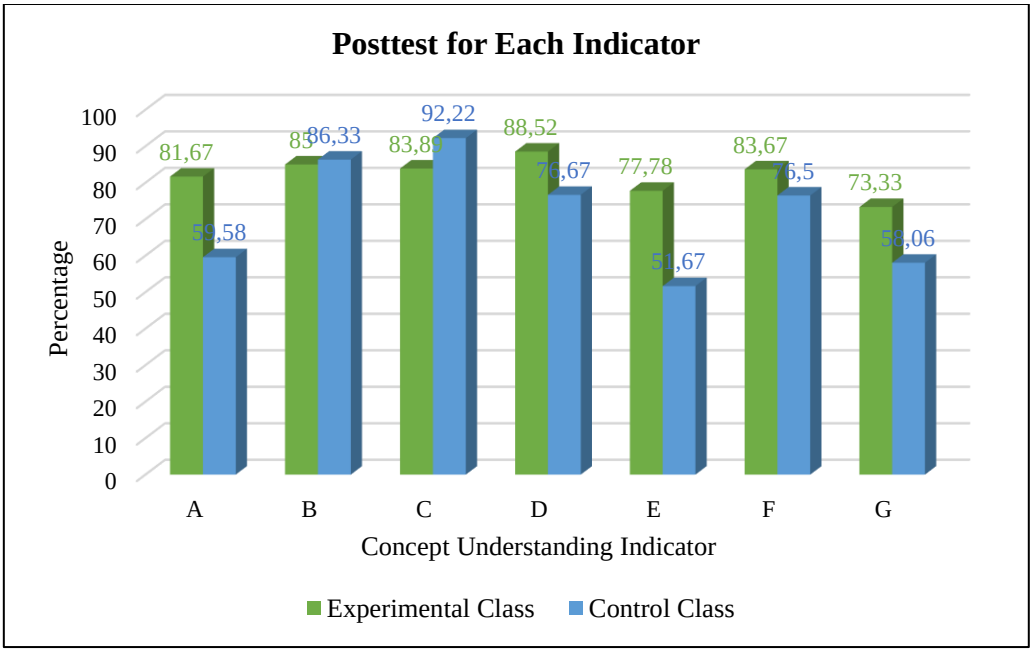

Fig. 1. Posttest Results for Each Concept Understanding Indicator

Based on the research results, students' conceptual understanding in the experimental class and the control class showed quite striking differences. In indicator A, the experimental class obtained a percentage of 81,67%, while the control class only achieved 59,58%. Indicator B shows almost balanced results, where the experimental class gets 85%, while the control class gets 86,33%. In indicator C, the experimental class achieved 83,89%, but the control class obtained higher results, namely 92,22%. Furthermore, on indicator D, the experimental class got 88,52%, while the control class got 76,67%. Indicator E shows that the experimental class has a percentage of 77,78%, while the control class only reaches 51,67%. On indicator F, the experimental class got 83,67%, while the control class got 76,5%. Indicator G showed a result of 73,33% in the experimental class, while the control class obtained 58,06%. From these results, it can be seen that students' conceptual understanding in the experimental class tends to be better than that in the control class. The posttest results of students' ability to understand mathematical concepts can be seen in the following table.

Table 4. Descriptive Posttest Results

Calculation	Experimental Class	Control Class
Average	86,09	75,14
Variance	19,83	37,87
Standard Deviation	4,45	6,15
Lowest Value	79,27	61,45
The highest score	96,34	90,36

Based on calculations, the average score for the experimental class was 86,09 with a variance of 19,83 and a standard deviation of 4,45, while the control class had an average score of 75,14 with a variance of 37,87 and a standard deviation of 6,15. The lowest score in the experimental class was 79,27 and the highest score was 96,34, while the control class had the lowest score of 61,45 and the highest score of 90,36. After getting the data, then carry out

prerequisite tests, namely normality and homogeneity tests. The results of the normality test can be seen in the following table.

Table 5. Normality Test Results

Tests of Normality			
	Shapiro-Wilk[a]		
	Statistic	df	Sig.
Experimental Class	.138	30	.152
Control Class	.102	30	.200

a. Lilliefors Significance Correction

Based on the above, it can be seen that the Shapiro-Wilk significance value with experimental class data is 1,152 > 0,05 and control class 0,200 > 0,05. So it is concluded that both data are normally distributed. After the two classes have a normal distribution, the next step is to test their homogeneity, with the following results.

Table 6. Posttest Value Homogeneity Test Results

Test of Homogeneity of Variances			
Value			
Levene Statistic	df1	df2	Sig.
2.093	1	58	.153

Based on the data above, the sig. is 0,153 > 0,05, so it can be said that the experimental and control classes are homogeneous. Next, a hypothesis test was carried out to determine the difference in the average understanding of the concepts of class VII students at Muhammadiyah 1 Mlati Junior High School on triangle material and to determine the effectiveness of the Scramble type cooperative learning model compared to the conventional model. Calculations are carried out using SPSS-25 as follows.

Table 7. Paired Samples Test Results

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Value	Equal variances assumed	2,093	,153	7,901	58	,000	10,958	1,386	8,181	13,734
	Equal variances not assumed			7,901	52,836	,000	10,958	1,386	8,175	13,740

Based on the above, the sig value. (2-tailed) is 0,000 < 0,05, so H_0 is rejected so there is a difference in student learning achievement before and after learning using the module. The following is a description of the pretest and posttest scores.

Discussion

This study was conducted to determine the effectiveness of the Scramble cooperative learning model in enhancing the mathematical conceptual understanding of seventh-grade students at Muhammadiyah 1 Mlati Junior High School. Before the research began, the researcher conducted observations and interviews with the mathematics teacher to obtain an

initial overview of the learning conditions at the school. Based on the results of the observations and interviews, the researcher decided to use the simple random sampling technique to determine the research sample. In the selection process, a random selection was conducted among the four available classes, ultimately selecting class VII-B as the experimental class and class VII-C as the control class.

Before administering the test, the posttest instrument was first piloted in class IX-A at Muhammadiyah 1 Mlati Junior High School, involving 30 students. This pilot test aimed to assess the validity, reliability, discriminating power, and difficulty index of the posttest items. The results of the pilot test indicated that the instrument was valid and reliable, making it suitable for measuring students' conceptual understanding at the end of the study.

The experimental class underwent learning using the Scramble model over two sessions, whereas the control class followed conventional learning methods, also over two sessions. Each session in the experimental class was supervised by three observers to ensure that the implementation of the learning process aligned with the planned procedure. The observation results regarding the lesson implementation showed that in the first session, the teacher's implementation reached 97,91%, categorized as excellent, while students' implementation reached 96,15%, also categorized as excellent. These findings indicate that the application of the Scramble model was well-executed and adhered to the observed aspects.

After completing the learning sessions, students in both the experimental and control classes took the posttest to measure their mathematical conceptual understanding [26], [27]. This posttest aimed to compare the conceptual understanding between students who were taught using the Scramble model and those who were taught using conventional methods. The results of the normality test showed that the posttest scores in the experimental class had a significance value (sig.) of 0,152 > 0,05, while in the control class, the sig. value was 0,200 > 0,05, indicating that the posttest scores in both classes followed a normal distribution.

Furthermore, the homogeneity test resulted in a sig. value of 0,153 > 0,05, indicating that the variance of posttest scores between the two classes was homogeneous. Since the prerequisite tests were met, a t-test was conducted to test the hypothesis. The hypothesis tested was whether the Scramble learning model was effective in enhancing students' mathematical conceptual understanding. The results of the t-test calculation showed a sig. (2-tailed) value of $0.000 < 0.05$, leading to the rejection of the H_0, which stated that the Scramble learning model was not effective. These findings indicate that the Scramble cooperative learning model has a significant impact on the mathematical conceptual understanding of seventh-grade students at Muhammadiyah 1 Mlati Junior High School on the triangle topic.

Based on the research findings, it is evident that the Scramble cooperative learning model is effective in enhancing students' mathematical conceptual understanding. This finding is consistent with Murjinah et al. [28], Novia et al. [29], and Yasin et al.[30], which states that learning models that actively engage students are more effective in helping them comprehend the concepts being taught. By implementing the Scramble model, students can better understand mathematical material because learning is conducted in a more interactive and creative manner [31], [32].

This study makes a significant contribution to the development of more innovative mathematics teaching methods. The Scramble cooperative learning model can be applied as an effective alternative to enhance students' mathematical conceptual understanding, not only at Muhammadiyah 1 Mlati Junior High School but also in other schools with similar conditions. This research is expected to provide new insights for the development of more effective and engaging learning methods for students.

CONCLUSION

The conclusion of this study is that the Scramble type cooperative learning model is effective in improving mathematical conceptual understanding of grade VII students of Muhammadiyah 1 Mlati Junior High School. This is supported by the results of the t-test which shows a sig. (2-tailed) value of 0,000 < 0,05 which indicates that the Scramble model has a significant effect on conceptual understanding. This study provides an important contribution to the development of more innovative mathematics teaching methods. Future research can explore the long-term effects of the Scramble learning model and its application to other mathematics topics.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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